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Wastewater Wetlands Urban Landscape Implications and Opportunities

A thesis

submitted in partial fulfilment

of the requirements for the Degree of

Master of Landscape Architecture

at

Lincoln University

by

Stephen Skelton

Lincoln University

2012

Abstract of a thesis submitted in partial fulfilment of the
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An emerging water crisis is on the horizon and is poised to converge with several other impending problems in the 21st century. Future uncertainties such as climate change, peak oil and peak water are shifting the international focus from a business as usual approach to an emphasis on sustainable and resilient strategies that better meet these challenges. Cities are being reimagined in new ways that take a multidisciplinary approach, decompartmentalising functions and exploring ways in which urban systems can share resources and operate more like natural organisms. This study tested the landscape design implications of wastewater wetlands in the urban environment and evaluated their contribution to environmental sustainability, urban resilience and social development. Black and grey water streams were the central focus of this study and two types of wastewater wetlands, tidal flow (staged planning) and horizontal subsurface flow wetlands were tested through design investigations in the earthquake-affected city of Christchurch, New Zealand. These investigations found that the large area requirements of wastewater wetlands can be mitigated through landscape designs that enhance a matrix of open spaces and corridors in the city.

Wastewater wetlands when combined with other urban and rural services such as food production, energy generation and irrigation can aid in making communities more resilient. Landscape theory suggests that the design of wastewater wetlands must meet cultural thresholds of beauty and that the inclusion of waste and ecologies in creatively designed landscapes can deepen our emotional connection to nature and ourselves.

Keywords: Landscape architecture, blackwater, greywater, wastewater, wetlands, landscape performance, green infrastructure, sustainability, resilience, aesthetics, Christchurch.

This thesis is dedicated to all those who know;
water is too precious to waste.

ACKNOWLEDGEMENTS

My Supervisors: Mike Barthelmeh and Neil Challenger

My supportive fiancée: Shana D. Payne

My mother Janis Normoyle

father, Russell Skelton

and stepmother Jill Skelton

and those who helped me along the way:

Tony Milne, Wayne Rimmer, Dr. Jacky Bowring, Julia Moore,

Dr. Andrew Dakers, Mike Bourke, Parker Goodyear and

Meredith Dobbie.

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September 2012

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Personal Profile

This thesis is the culmination of a six-year quest to find alternatives to wasteful water practices. Water has always been an element of mystique to me. Growing up in the parched deserts of Phoenix, Arizona I used to celebrate the autumn monsoons and remember riding a body board down the flooded streets after intense rains. Back then in the early 80's the monsoons still penetrated central Phoenix as it was just a small city surrounded by a beautiful desert landscape. The city has since gained 3-million people and sprawled into the surrounding wild, replacing the cactus with concrete and relegating the monsoons to the margins with an intense urban heat island effect. The rapid growth of "The Valley of the Sun" was facilitated by massive infrastructural projects that damn the Colorado and Salt Rivers and pump water from them through hundreds of miles of canals. If the water infrastructure that supports Phoenix were to fail for any reason, the populations would wither and die.

After receiving a BA in Communication from Northern Arizona University I moved to the southern hemisphere to become an outdoor educator and adventure guide. My work and personal experience as an avid adventurer has taken me to many remote destinations around the world. Through over a decade of facilitating human experiences in nature, I gained an insight into the power of immersive exposure to natural environments and an understanding of how my students, clients and co-workers left these experiences with a deeper understanding of themselves and the world.

As my love for guiding waned, I looked deeper into my passions and joys to find a new path. Inspired by architects, futurists and sustainability advocates I enrolled at the ECOSA Institute of Sustainable Design. At ECOSA I learned the basics of design disciplines while being immersed in a culture of like-minded people interested in environmental and social sustainability. Urban design and landscape architecture became my main focus and I returned to New Zealand to study landscape architecture at Lincoln University.

When I began my studies at Lincoln I set a goal to include an element of water efficiency in every design. I've managed to meet that goal and in close to three-years at Lincoln I've gained a reputation as the "water guy". When choosing a topic for this thesis I chose to research the landscape implication and opportunities concerned with urban black and grey water streams, "not because they are easy, but because they are hard," (Kennedy 1962). In doing so I tackled more than the issues of water, but also waste and cultural values. I believe that by reconsidering the relationships between the built environment, ecology, water and waste, designers can facilitate a cultural transformation to an understanding of humans being embedded in nature and in doing so this transformation can help solve many of the woes in the world. Much of the research in this thesis reflects and validates that belief. I believe the evolution of ecological water treatment and the progressing concepts of green urbanism can forge a path towards symbiotic natural, social and urban systems in a safe and sustainable world.



Figure 0.1 Steve Skelton at the Wat Tham Phou Si, Luang Prabang, Laos.

Glossary of Terms and Acronyms

Blackwater: Water containing solid and liquid wastes from toilets and urinals.

Cascading Water System: Where water is treated only enough to make it suitable for its next use.

CWTP Christchurch Wastewater Treatment Plant: The existing wastewater treatment plant in Christchurch.

POSS: Public Open Space Strategy 2012 – 2040 (2010) is a Christchurch City Council planning document outlining open space strategies and objectives.

CERA: The Christchurch Earthquake Recovery Authority is a national government agency appointed to guide and oversee the recovery of Christchurch.

GCA: the Greater Christchurch Area encompassing the Christchurch City (including Banks Peninsula) and parts of the Waimakariri and Selwyn Districts.

Greywater: Wastewater discharged from sinks, showers, laundry, drinking fountains, etc. but does not include toilets and urinals. Greywater can be broken up into two other sub classifications:

Light greywater: Water from bathroom sinks, showers, bathtub, laundry and drinking fountains.

Dark greywater Water from kitchen sinks and dishwashers that contains a higher level of contaminants.

Haptic: Refers to the sense of touch and the tactile appearance of materials.

HSFCW Horizontal Subsurface Flow Constructed Wetlands:
Constructed wetlands that mimic the water-purifying process that occurs in natural wetlands through a combination of biological and chemical process below the surface of a gravel medium that supports emergent wetland plants.

IWRM Integrated Water Resource Management: Promotes the coordinated management of water, land and related resources to maximise the social, economic and ecological benefits.

Liquefaction: The process by which wet sediment starts to behave like a liquid. Liquefaction occurs because of the increased pore pressure and reduced effective stress between solid particles generated by the presence of liquid. It is often caused by severe shaking, especially that associated with earthquakes.

Metrics: system of related measures that facilitates the quantification of some particular characteristic. In the context of landscape, an example could be the amount of wastewater a wetland can process or the number of species an area could support.

Peak oil: The point in time when the global production of oil will reach its maximum rate, after which production will gradually decline.

Peak Phosphorus: The point in time at which the maximum global phosphorus production rate is reached.

Peak Water: When the rate at which water demanded is higher than the rate at which the supply is replenished.

Performance Landscapes: Defined by Nate Cormier of SVR Designs as the optimization of a sites geologic, hydraulic, biologic, metabolic, circulation and habitat systems and the synthesis of those systems as a place. (LAF 2012).

Resilience: the ability to recover quickly from change.

Stormwater: Water from precipitous events that falls on the roof or ground surface.

Supermodern: a term coined by Mira Engler (2004) to describe the approaching era; post post-modern.

UDS: The Urban Development Strategy is a 2004 planning document developed in partnership with Environment Canterbury, the Christchurch City Council, Selwyn District Council, Waimakariri District Council, the New Zealand Transport Agency and Te Runanga o Ngai Tahu.

Wastewater: Water mixed with waste matter. It can be a combination of storm, grey and black water. For the purpose of this thesis wastewater refers to combined grey and black water and stormwater is referred to separately.

